

Claims

- [c1] 1. A method for controlling the manufacture of a spray-formed metallic tool, comprising:
applying a metallic spray-forming material upon a mold substrate in the manufacture of a spray-formed tool, and
controlling metallic phase transformations of the spray-forming material via a manipulation of temperature and time maintained at a predetermined temperature of the spray-formed tool during application of the spray-forming material.
- [c2] 2. The method of claim 1, wherein controlling the metallic phase transformations further comprises causing the occurrence of preselected phase transformations of the spray-forming material via the manipulation of temperature and time maintained at the predetermined temperature.
- [c3] 3. The method of claim 2, wherein causing the occurrence of the preselected phase transformations further comprises causing a predetermined strategic volumetric expansion associated with the preselected phase transformations via the manipulation of temperature and time maintained at the predetermined temperature.
- [c4] 4. The method of claim 3, wherein causing the predetermined strategic volumetric expansion associated with the preselected phase transformations further comprises causing preselected phase transformations to a mixed-phase makeup consisting of at least martensite and bainite in predetermined proportions via the manipulation of temperature and time maintained at the predetermined temperature.
- [c5] 5. The method of claim 4, wherein causing the predetermined strategic volumetric expansion associated with the preselected phase transformations further comprises causing preselected phase transformations to a mixed-phase makeup consisting of at least martensite, bainite, and pearlite-ferrite in predetermined proportions via the manipulation of temperature and time maintained at the predetermined temperature.

- [c6] 6. The method of claim 3, wherein causing the predetermined strategic volumetric expansion associated with the preselected phase transformations further comprises allowing a preselected phase transformation to martensite that is less than a complete transformation to martensite and thereafter increasing and maintaining a temperature of the spray-formed tool above a martensite start temperature for the spray-forming material for a predetermined time.
- [c7] 7. The method of claim 6, wherein allowing the preselected phase transformation to martensite further comprises applying the spray-forming material to a substrate having an initial temperature below the martensite start temperature.
- [c8] 8. The method of claim 7, wherein increasing the temperature of the spray-formed tool above the martensite start temperature further comprises applying the spray-forming material at a temperature that is above the martensite start temperature.
- [c9] 9. The method of claim 8, wherein increasing and maintaining the temperature of the spray-formed tool above the martensite start temperature further comprises increasing the temperature of the spray-formed tool to a saturation temperature of the spray-formed tool and substrate that is above the martensite start temperature by continuing to apply the spray-forming material.
- [c10] 10. The method of claim 3, wherein causing the predetermined strategic volumetric expansion associated with the preselected phase transformations further comprises allowing a preselected phase transformation to bainite in the spray-formed tool that is less than a complete transformation to bainite and thereafter decreasing the temperature of the spray-formed tool below a martensite start temperature for the spray-forming material.
- [c11] 11. The method of claim 1, wherein controlling the metallic phase transformations via the manipulation of temperature and time further comprises manipulating the temperature and time maintained at the predetermined temperature by controlling at least one ongoing spray-forming parameter

